

Evaluating the Potential use of Pin Diodes in Transmission Mode for Microbeam EXAFS Analysis

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Beamline(s): X26A

Introduction: A long-term goal of the X26A PRT group is in the improved acquisition of high-quality EXAFS data of natural materials collected using focused x-ray beams with spatial resolutions of about 10 microns. But as discussed by Hunter and Rao (2000), a number of issues negatively affect EXAFS analysis when beam sizes are so small. One clear limitation is data throughput. If analyses are done in transmission mode, for example, such small beams typically ionize less gas, with resultant lower count rates. We have begun evaluation of the potential use of inexpensive pin-diodes in transmission mode for use in micro-beam EXAFS analysis with encouraging initial results.

Methods and Materials: These feasibility measurements were conducted at the X26A beamline. The incident beam was tuned using a Si(111) channel cut monochromator, collimated to 300 microns in diameter, and then focused to about 10 microns using a set of Kirkpatrick-Baez microfocusing mirrors developed by Peter Eng at U. Chicago. I_0 was monitored using a mini-ion chamber developed by the author. Transmission counts were monitored using a Hamamatsu pin diode (roughly 25 mm² surface area), with a unit cost of about \$12.00. The pin diodes were mounted in custom aluminum chambers with aluminized mylar windows to exclude external sources of light. Count rates were typically 2-3 orders of magnitudes higher than ion in chamber assemblies that were tested in this study.

Results: Initial results were evaluated based on analysis of reference EXAFS metal foils obtained from EXAFS Materials, Inc., generally with very good agreement to reference spectra. For example, in Figure 1 we show the reference spectra for Zr foil and that obtained by x-ray microbeam pin-diode transmission mode analysis. The spectra are generally in very good agreement through at least 600 eV above the absorption edge.

Conclusions: Although a number of complexities exist in obtaining high-quality microbeam EXAFS data, the use of inexpensive pin-diodes used in transmission mode may potentially be useful for these types of measurements, providing data throughput that can be orders of magnitude higher when compared to ion-chambers run in similar mode.

Acknowledgments: Much of the initial concept development for this project came from Doug Hunter (SRS).

References: Hunter and Rao (2000), Micro EXAFS at X26A, NSLS 2000 Annual Report, abstract.

Figure 1. Comparison of reference x-ray spectra of Zr metal foil (left) and x-ray spectra collected in transmission mode at X26A with a 10 micron focused beam in a pin-diode detector (right).

